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THE NATURE OF MAN[1]

A FEW years ago, as you may remember, Élie Metchnikoff published a book entitled "The Nature of Man: Studies in Optimistic Philosophy." If you have read that interesting work, you know that it is chiefly concerned with the great problem of death—with the problem, that is, of adjusting human emotions and human understanding satisfactorily to the common doom of living creatures. In Metchnikoff's view that problem has been mainly responsible for the existence of religions and philosophies. In his belief religions and philosophies have not been able to deal with the problem satisfactorily; but their failure, says he, is no reason for despair; for it is his conviction—and here we see why he deemed his study to be one in optimistic philosophy—that the problem can be satisfactorily solved by science and in particular by the science of biology, for the process of dying is one of the processes of life. And so his book aims at being an important contribution to what may be called the science or the philosophy of death.

I hope that this address upon "The Nature of Man" may appear to you, as it appears to me, to be, likewise, a study, or the result of a study, in optimistic philosophy. It is not of death, however, that I intend to speak, but of life. I desire to look towards the possibility—to contemplate the possibility—of a valid philosophy, or a science, of human life.

The core of my message is a certain concept—a concept regarding the essential nature of man. The concept is, I believe, both new and important—strictly new, if I be not mistaken, and tremendously important. This judgment I may express with propriety because the idea

[1] Address at the annual meeting of the Phi Beta Kappa Society, Columbia University, May 31, 1921.

in question did not originate with me. I should be proud if it had. I encountered it a little less than a year ago in an unpublished manuscript which by good fortune it became my privilege to examine. And so the conception is mine only by acquaintance, by meditation upon it, by a steadily growing sense of its significance, and by adoption—adoption of it, I mean, as an inspiring idea of great beauty and as a fruitful working hypothesis. The manuscript, I am happy to report, is now being published (by E. P. Dutton and Company) in the form of a book entitled "The Manhood of Humanity: The Science and Art of Human Engineering," and will appear very soon. The author of it is a Polish nobleman, Count Alfred Korzybski, a native citizen of Warsaw, by temperament a poet and philanthropist, by training and experience a mechanical engineer and soldier, twice wounded in the war; about six years ago transferred as a military expert to North America where, both in the United States and in Canada, he worked hard in the cause of freedom.

The book is, in my opinion, a momentous contribution to the best thought of these troubled years—momentous in what it contains, even more so in what it suggests, and most of all, I dare say, in the excellent things it will eventually help men and women to think and say and do. I am not going to review it on this occasion. Having examined the work carefully and reflected much upon it, I am convinced that its significance can be grasped and felt, not indeed by reading or listening to any review of it, but only by reading the work itself, re-reading it and pondering it. What I purpose to do is at once something less and something more—I hope a good deal more—than the submission of a review. The work deals with a wide variety of ideas; these do not constitute a mere collection; they constitute a system—the ideas are connected—logically connected—spiritually interlocked in many ways. It happens that among the ideas of the system there is one which dominates all the rest, binding them together, giving them their proper order, their life, their light and their significance—its place in the system is like that of the sun in the solar system. That central idea is Korzybski's concept of Man—a concept of what is characteristic of humankind; it is, in other words, a thesis purporting to state what that is in virtue of which we human beings are human. I desire in the first place to present that thesis, or conception, as clearly as I can, for your consideration both now and in the future; it will be my further aim to indicate, in so far as time allows, some of the bearings it seems to me to have upon the cardinal interests of mankind.

The task is not easy to perform well in the time at our disposal. In trying to perform it, I am going to invite you to join me in an attempt to do a little fundamental thinking. I extend the invitation confidently for the reason that the mood of such thinking is the only mood that befits the times. The World War has indeed constrained us to think about realities as we never thought before, and there is one thing of which we are all of us convinced—it is only by thinking of realities that we may hope to solve the pressing problems of the world. That is a great gain and is full of promise but it is only a beginning. In this presence it is unnecessary to argue that in dealing with realities it is of the highest importance to have just conceptions of them; I desire to emphasize the prime importance of concepts that correspond to facts; certainly in this presence it is unnecessary to argue that, in order to deal successfully with the great human problems of our time, it is not sufficient to have enthusiasm, sincerity and goodwill; we know that, in addition to these excellent things, it is indispensable to acquire true conceptions of the realities involved. Now, of all the realities with which we humans have to deal, of all the realities involved in the present perplexities of the world, it is evident that the supreme reality is man. It follows that of all the questions we human beings can ask—of all the questions which in reflecting upon the ills of our time we *must* ask—the supreme question—the most fundamental question—is: What is man? What is a human being? What is the defining or

characteristic mark of humankind? In the scheme of nature, what is the place—the distinctive place—of the human class of life?

The sovereign importance of that question seems perfectly evident and is thus evident *a priori*. Have we propounded it to ourselves? In the published thought of recent years I see no sign that we have; if we have, it seems not to have led us to the discovery of anything fundamentally new or fundamentally important. It is safe to say that we have not asked the question—at all events not seriously. And it seems a bit strange that we have not; for many questions closely connected with it and naturally leading to it we have asked. Rudely reminded of the dismal things of human history, we have asked: What is the explanation of them? Can we prevent their recurrence? And, if so, how? Keenly aware of the present plight of the world, we have asked: What is the cause? Are we humans under the dominion of a malevolent fate? Or is there a cure? And, if there be a cure, what is the remedy? In trying to answer these great questions, we have been led to ask others—questions about ethical systems or ethical beliefs, about national or racial philosophies, about education, about industrial methods, about economics, about jurisprudence, political science and theories of government. We have beheld the amazing progress of invention, of natural science, of mathematics, and the technological sciences; we have seen their swift conquests of space, time, and matter; we have seen our globe thus rapidly reduced to the small dimensions of an ancient province; we have seen many peoples of divers tongues, traditions, customs and institutions consequently constrained to live together as in a single community; we have seen that there is thus demanded a new ethical wisdom, a new legal wisdom, a new educational wisdom, a new economical wisdom, a new industrial wisdom, a new political wisdom, a new wisdom in the affairs of government; for the new wisdoms our anguished times cry aloud; we have heard the answers—which are in the main but reverberated echoes of the wailing cry mingled with the chattering voices of excited public men who know not what to do; knowing that the welfare of the world, since it depends at once upon *all* the cardinal forms of human activity, demands team-work of them and therefore *equal* progressiveness in all of them, we have compared the swift advancement of the genuine sciences, on the one hand, with the slow, uncertain, halting pace of the so-called social sciences, on the other; we have been astounded by the contrast; in the crumpled and broken condition of our civilization we behold the appalling consequences of the mighty disparity; and so we have asked why it is that the social sciences—of ethics, education, jurisprudence, economics, politics, and government—have lagged so far behind the forward strides in the other great fields of human activity that the system of human relationships throughout the world has been strained and torn asunder like an immense network of wire rent by a cyclone. This very important question has led to some curious results. It has led to the invention of doctrines that alarm, to proposals that startle,—doctrines and proposals that we are wont to call radical, revolutionary, red. Is it true that our thinking has been too radical? The trouble is that, in the proper sense of that much abused term, our thinking has not been radical enough. Our questionings have been eager and wide-ranging but our thought has been shallow; it has been emotional and it has been daring but it has not been deep. We have indeed known that the character and status of the so-called human or social sciences depend upon what man *is*; but we have not reflected upon the fact that they depend also, in equal or greater measure, upon what we humans *think* man is. The fact of this fundamental dependence, had we considered it, would have led us to a further reflection—it would have led us to wonder whether the backwardness, the mediæval-mindedness, the disastrous lagging of the social sciences may not be due to their having at their base or in their heart a fundamentally false conception or false conceptions of what is really characteristic of humankind. It is evident that, if

our thinking had reached that point, we could not have failed to ask ourselves the supreme question: What is man?

Why have we not in these times asked that fundamental question? Doubtless it is because we have assumed, in the main unconsciously, that we know the answer. For why enquire when we are sure we know? Is our assumption of knowledge in this case just? Have we really known, do we know now, what is in fact the idiosyncrasy of the human class of life? Do we critically know what we, as representatives of man, really are? Here it is essential to distinguish; we are speaking of knowledge; there is a kind of knowledge that is instinctive—instinctive knowledge—immediate inner knowledge by instinct—the kind of knowledge we mean when we say that we know how to move our arms or that a fish knows how to swim or that a bird knows how to fly. I do not doubt that, in this sense of knowing, we do know what human beings are; it is the kind of knowledge that a fish has of what fishes are or that a bird has of what birds are. But there is another kind of knowledge—scientific knowledge—knowledge of objects by analyzing them—objective knowledge by concepts—conceptual knowledge of objects; it is the kind of knowledge we mean when we say that we know or do not know what a planet is or what a number is. Now, we do not suppose fish to have this sort of knowledge of fish; we do not suppose a bird can have a just conception—nor, properly speaking, any conception—of what a bird is. We are speaking of concepts, and our question, you see, is this: have we humans a just concept of man? If we have, it is reasonable to suppose that we inherited it, for so important a thing, had it originated in our time, would have made itself heard of as a grave discovery. So I say that, if we have a just concept of man, it must have come down to us entangled in the mesh of our inherited opinions and must have been taken in by us, as such opinions are usually taken in, from the common air, by a kind of "cerebral suction."

Well, what are the concepts of man that our generation has thus inherited? Broadly speaking, they are of two types. One of them is biological or zoological; the other one is mythological. Some of us hold the former one; some of us the latter; and some of us probably hold both of them; for, though they are mutually incompatible, mere incompatibility of two ideas does not necessarily prevent them from finding firm lodgment in the same brain. According to the zoological conception, man is an animal—a kind or species of animal. This conception has at least one merit—it regards human beings as natural—as creatures having a place in the scheme of nature. This merit the mythological conception has not; according to it, man has strictly no place in nature—he is indeed neither natural nor supernatural but is both at once—a kind of miraculous union, compound, or hybrid of the two. Such, then, are the concepts of man that now reign throughout the world and that have so reigned from time immemorial. And such are the concepts that have fashioned our so-called human or social sciences in so far as these have been and are fashioned by what we humans consciously or unconsciously *think* man is.

Are the concepts true? Or rather we must ask—since they can not both of them be true—is one of them true?

It should not amaze us to find that both are false; for the concepts are man's and their object is man; thus the difficulty is unique; it is that of a self-conscious being having to regard its kind as an object and rightly conceiving what the object is. In respect of the mythological conception, there are no doubt some who are disposed to treat it ironically as only the other day it was treated by Plato, for example. "We must accept," said he, "the traditions of the men of old time who affirm themselves to be the offspring of the gods—that is what they say—and they must surely have known their own ancestors. How can we doubt the word of the children of the gods? Although they give no probable or certain proofs, still, as they declare that they are speaking of what took place in their own family, we must conform to custom and believe them." But this gentle irony—the way

of the Greek philosopher—is not the way of the Polish engineer. The latter is not indeed without a blithesome sense of humor but in this matter he is tremendously in earnest; deeming it to be immeasurably important for all mankind, he treats it with the utmost seriousness; and he bluntly affirms, boldly and confidently, that neither the mythological conception nor the zoological conception of man is true; he denies outright that man is a species of animal and similarly denies that humans are compounds of natural and supernatural.

What is the error in those traditional conceptions? It is, he contends, of the same kind in both of them, and the kind is fundamental. It is the kind of error that consists in what mathematicians call confusion of types and what Korzybski calls mixing of dimensions. Let me explain; I have only to remind you of what everybody knows. And the simplest explanation is the best. You and I may speak of, say, the class of geometric points or of the class of spheres but we can not speak logically of a class composed of points *and* spheres for there is no such class; or we may speak of the class of water-drops or of the class of oceans but not logically of a class of water-drops *and* oceans; the types are different and must not be confused; to talk as if there were such a class is to talk nonsense, and it would be the same if we tried to discourse rigorously about a class composed of stars *and* rays of light; it would be to chatter as if there were no such thing as logic, or laws of thought. The matter is even clearer in terms of dimensions, or dimensionality; pardon me for dwelling upon it—it is so very important: here is a straight line—it has length only—it is a one-dimensional thing; it is not a point; it does contain points and it has some point properties, but, if on this account we called it a point, we should be guilty of a type-confusing blunder; next consider a surface, say a plane—it has length and breadth—it is a thing of two dimensions; it contains points and lines and it has certain point properties and certain line properties; but we do not call it a point or a line; if we did the blunder would be a dimension-mixing blunder; once more, here is a solid, say a cube—it has length, breadth and thickness—it has three dimensions; it has surfaces and it has certain surface properties, but it is not, therefore, a surface; if we called it a surface or if we were to say it is a surface mysteriously combined with some miraculous influence from outside the universe of space, then in either case we should be guilty of treason against the eternal law of types or dimensions.

In the light of such elemental considerations we are going to see very soon and, I hope, very clearly what kind of beings we humans are according to Korzybski's concept of man and at the same time why he condemns the traditional conceptions as false. Consider the great life classes of our world—consider their patent cardinal distinctions and relations candidly and open-mindedly; and let us begin with the class of plants. I offer, as I need offer, only a rude sketch. Plants, we say, are living things. How are they characterized as a class, positively and negatively? They take in, chemically transform, organize and appropriate the basic energies of sun, soil and air; but they have not the *autonomous* power to move about in space; together they constitute the lowest order or class or type or dimension of life—say, for convenience, the life dimension I; being, as indicated, binders of the basic energies of the world, the plants are, in Korzybski's nomenclature, the basic-energy-binding, or chemistry-binding, class of life. What of the animals? What, I mean, are we to say of the creatures traditionally designated as the "lower" animals? Like the plants, animals, too, take in, transform, organize and appropriate the energies of sun, soil and air, though in large part they take them already prepared by the plants; but unlike the plants, animals possess the *autonomous* power to move about in space—to creep or crawl or swim or run or fly; it is thus evident that, compared with plants, animals belong to a higher type or dimension of life—say the life dimension II; the classification we are here interested in, you see is broad; because they are distinguished by

their autonomous power to move, to abandon one place and occupy another and so to appropriate the natural fruits of many localities, the animals are called space-binders—the space-binding class of life.

And now we come to the crux. What are we to say of man? Like the animals, human beings have the autonomous power to move—the capacity for binding space—for taking now one and now another "place in the sun" with the goods thereof, and it is plain that, if human beings had no capacity of *higher* order, men, women, and children would indeed be animals. But what are the facts? Be good enough to examine them carefully; they are familiar; let us, if we can, reflect upon them as if they were unfamiliar, for that is half the secret of philosophy and of science, too. Long, long ago, a quarter or half million years ago, there came into existence upon this globe—no matter how—a new kind of beings; they did not know what they were; they knew nothing of the world, nothing of its size or shape or place in the universe, nothing of its resources, their locations or properties, nothing of natural law; they were without guiding maxims, precepts or precedents; they had no science, no philosophy, no art, no wealth, no instruments, no history—not even tradition: their ignorance was almost absolute; and yet, compared with the animals, which they hunted and which hunted them, they were marvels of genius; for there was in them a strange new gift—a strange new energy—that mysterious power in virtue of which they did that most wonderful of all things—*initiated* the creative movement called civilization. That power, first manifest in the infancy of our race, is the power that invents, the power that imagines, conceives, reasons; it is the power that makes philosophy, science, art and all the other forms of material and spiritual wealth; the power that detects the uniformities of nature, creates history, and foretells the future; it is the power that makes *progress* possible and actual, discerns excellence, acquires wisdom, and, in the midst of a hostile world, more and more determines its own destiny. The animals have it not or, if they have, they have it in a measure so small that we may neglect it as mathematicians neglect infinitesimals of higher order. Do not fail to observe *how it relates us to that mysterious thing called Time,* which so many thinkers—psychologists, philosophers, astronomers, physicists, and mathematicians—are just now as never before engaged in studying, each in his own way. By virtue of that familiar yet ever strange human power, each generation inherits the fruit of the creative toil of bygone generations, augments the inheritance, and transmits it to the generations to come; thus the dead survive in the living, destined with the living to greet and bless the yet unborn. If this be poetry it is also fact. Past, Present and Future are not three; in man they are spiritually united to constitute *one living* reality. And now we behold, and are at length prepared to grasp, Korzybski's great Concept. Because this capacity for binding time, under a law of ever-increasing amelioration, is *peculiar* to man or is at all events his in an incomparable degree, the class of human beings is to be conceived and scientifically defined to be the Time-binding class of life. We have here, you see, a new dimension, a new type, of life—life-in-Time. Animals are binders of space; man is a time-binder. Allow me a word of caution. Since, like the animals, man, too, binds space, may we not say that man is a time-binding animal? No; to say that would be the same kind of blunder as to say that a solid is a surface because it has surfaces and some surface properties or to say that fractions are a species of whole numbers because they happen to have some of the properties of whole numbers. It is fatal to confuse types, or to mix dimensions. Time-binding activity—the defining mark of man—may involve and often does involve space-binding as a higher involves a lower; but to say that, therefore, man is a species of animal—a time-binding species thereof—is like saying that a solid is a species of surface or that water is a species of oxygen or that wine is a species of water or that a violin is a species of wood

or that definite integration is a species of addition or that a symphony is just a species of sound.

Such, then, is the new conception of man—the conception of a being whose character and appropriate dignity consist in his peculiar capacity or power for binding time. The nobility of the conception is obvious, unmistakable. It has two other marks that belong to all really great ideas—it is intelligible to all and is universal in its interest and appeal. Your sense of its significance, if your experience repeats my own, will grow as you meditate upon it, for its significance, I do not doubt, is mighty. The author, I believe, is right in his belief that it marks the beginning and will guide the development of humanity's manhood. I wish it were possible to examine here some of its bearings on the cardinal interests of mankind; but "the hour contracts" and I can do no more than barely allude to a few salient considerations.

One of them is that, though we human beings are indeed not a species of animal, we are *natural* beings: it is as natural for us to bind time as it is natural for fishes to swim or birds to fly.

That fact is fundamental. Another one, also fundamental, is this: time-binding power—the characteristic of humanity—is not an effect of civilization but is its cause; it is not civilized energy, it is the energy that *civilizes;* it is not produced by wealth, whether material or spiritual, but is the source and creator of both.

I come now to the gravest of considerations. Inasmuch as time-binding is the characteristic of humanity, to study and understand man is to study and understand the nature of his time-binding energies; the laws of human nature are the natural laws of these energies; to discover these laws is a task of supreme importance for it is evident that upon the natural laws of time-binding must be based the future science and art of human life and human welfare.

One of the laws we already know—not indeed precisely—but fairly well—we know its general type—and it merits our best attention. It is the natural law of progress in time-binding, or civilization-building. Let us glance at it. Each generation of (say) beavers begins where the preceding generation began; that is a law for animals—there is no advancement, no time-binding—a beaver dam is a beaver dam. Contrast this with human life. Man invents and discovers and creates. An invention or discovery or creation once achieved, what happens? Each invention leads to new inventions, each discovery to new discoveries, each creation to new creations; invention breeds invention, science begets science, the children of knowledge and art and wisdom produce their kind in larger and larger families; each generation begins, not where its predecessor began, but where it ended; things done become instruments for the doing of better things; the Past survives in the living achievements of the dead; the body of these achievements—invention, science, art, wisdom—is the living capital of the ever passing Present, inherited to be held in trust for enlargement and for transmission to Future man; the process is that of time-binding: Past and Future are thus united in one eternal Now owning a law of perpetual growth and continual progress. What is the Law thereof—the natural law? You see at once what it is: it is that of a rapidly increasing geometric progression—if P be the progress made in a given generation, called the first, and if R be the ratio, then the progress made in the second generation is PR, that in the third PR^2, and that made in the single Tth generation will be PR^{T-1}. Observe that R is a large number and that the time T enters as an exponent—and so the expression PR^{T-1} is called an *exponential function of Time.* This is an amazing function; as T increases, the function not only increases but does so at a rate which itself increases according to a similar law, and the rate of increase of the rate of increase again increases in like manner, and so on endlessly, thus sweeping on towards infinity in a way that is truly marvelous. Yet that is the law—the natural law—for the advancement of civilization—

immortal offspring of the marriage of Time and human Toil.

And here arises a great question which I have hardly time enough to touch. The question is: Has civilization always advanced in accord with the mentioned law? And, if not, why not? The time-binding energies of man have been in operation long—300,000 to 500,000 years, according to the witness of human relics, ruins and records of the caves and the rocks. If progress had followed the mentioned law throughout that vast period, our planet would no doubt be now clothed with a civilization so advanced that we are powerless to imagine it or to conceive it or even to conjecture it in dreams. And yet that law is a natural law of the time-binding energies of man. What has been the trouble? What the main trouble has been is pretty plain. As already said, what we human beings do depends, not merely upon what we are but, in equal or greater measure, upon what we *think* we are. From time immemorial the characteristic energies of our humankind have been hampered by the false conception that man is a species of animal and hampered by the false conception that man is a miraculous mixture of natural and supernatural. Throughout the long period of our race's childhood, from which we have not yet emerged, those misconceptions have lain athwart the course of civilization. All that is precious in present civilization has been accomplished in spite of them. The goods, the glorious achievements, of which they have *deprived* the world, we can not now know but the subtle ramifications of their *positive* evil we can trace in a thousand ways. And it is your duty and mine to trace them. Whoever preforms the duty will be appalled. I can not dwell upon the matter here. Suffice it to say that, if we humans do not in fact constitute a perfectly natural class of life, then there never has been and never can be a human ethics having the understandability, the sanction and the authority of natural law; if we do constitute such a class of life but continue to *think* we do *not*, the result will be much the same—our ethics will continue to carry the confusion and darkness produced by the presence in it of mythological elements. If, on the other hand, human beings continue to regard man as a species of animal, then the social life of the world in all its aspects will continue to reflect the misconception; especially our ethics, which subtly pervades, colors and fashions all of the social sciences, will continue to be—what it always has been in large measure—a zoological ethics, animal ethics, the ethics of tooth and claw, space-binding ethics, the ethics of strife, violence, combat and war.

So it has been, but it will not continue so to be if we have the wisdom to learn the fundamental lesson of our recent experience. What is that lesson? It is this: the World War was an unforeseen, sudden, cataclysmic demonstration of human ignorance of human nature—a demonstration, pitiless as fate or famine, that human beings have never rightly conceived Man to be what Man is—not a mixture of natural and supernatural nor a species of animal, but the natural agency for those time-binding energies in the world whose peculiar function it is to produce civilization and to do so in conformity with its marvelous law of an increasing function of time.

That conception will be found, I believe, to initiate a new epoch—the epoch of humanity's manhood. The concept is easy to grasp—all, and especially the young, can understand it. Once it is understood, human life will accord with human nature, the time-binding energies will be freed from the old bondage, and civilization will at length advance in accord with its natural Law as the great forward-leaping exponential function of Time. There will be great changes and many transfigurations. Education—education in home, school and church—will have for its supreme function to teach the children of man what man is and what they are. Ethics will abandon the space-binding standards of animals and will become *human* ethics based upon the natural laws of the time-binding energies of man. Freedom will be freedom to live in accord with those laws and righteousness will

be the quality of life that does not contravene them. The social sciences of ethics, education, economics, politics and government will become what they never have been—genuine sciences; fashioned by a just conception of man, they will cooperate to fashion the state; and the state, which may ultimately embrace the world, will rescue itself from ignorant politicians and commit its destiny to the guidance of *honest* men who *know*.

And when guided by honest men who know—when guided, that is, by the coming science of human engineering, which will be intelligence applied to human affairs—when thus guided in the light of the true conception of man as the binder of time—then and only then our human civilization—the living issue of time-binding toil, mainly that of the dead—will advance, not haltingly as hitherto, but, as said, in accord with the natural law thereof, in a warless world, swiftly and endlessly.

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MENDELIAN OR NON-MENDELIAN?

IN 1907, several years after the Mendelian discoveries had begun to attract general interest, a writer endeavored to limit "Mendelian heredity" to the occurrence of 3 to 1 phenotypic ratios. All other ratios were held to represent other systems of inheritance. This extreme view was not held by any one actually engaged at that time in genetical investigations, and the paper referred to was entirely ignored by geneticists because its author was so obviously ignorant of the real implications of the Mendelian discoveries.

Recently, two of our foremost geneticists[1] have gone to the opposite extreme in stating what should be included in Mendelian heredity, declaring that "Mendelian heredity has proved to be the heredity of sexual reproduction; the heredity of sexual reproduction is Mendelian." Certainly few geneticists would at the present time include so much under the term "Mendelian heredity," though one,[2] at least, there is, who sympathizes with this dictum.

Between these extreme views as to the meaning to be attached to the expression "Mendelian heredity" different geneticists have taken different positions and even one and the same writer has given the term different meanings at different times. These differences of usage have led to misunderstandings and to some controversy.

Davis[3] has placed the mere occurrence of segregation in the Œnotheras equivalent to Mendelian inheritance, thus accepting the validity of a criticism made by East[4] based on the same conception as that quoted above from East and Jones, that all heredity in sexual reproduction is Mendelian. As I understand it, however, the occurrence or non-occurrence of segregation in the Œnotheras has never been an important issue; the real question has been whether the segregation which does quite obviously occur is of the Mendelian type, *i.e.*, whether the hereditary factors are distributed during gametogenesis and fertilization according to the formulation actually developed by Mendel in interpreting the results of his experiments.

Other writers[5] have grouped the phenomena of segregation under the terms "Mendelism" and "neo-Mendelism," but include under the latter name several phenomena which are now generally recognized among geneticists as differing in no essential way from the actual cases studied by Mendel. Still others speak of "orthodox" Mendelism, implying that there is also a "heterodox" Mendelism, or they use the expressions "strictly Mendelian,"

[1] East, E. M., and Jones, D. F., "Inbreeding and Outbreeding." 285 pp. Philadelphia: J. B. Lippincott Co., 1919. See p. 50.

[2] Wright, S., "Systems of mating. I. The biometric relations between parent and offspring." *Genetics*, 6: 111–123. 1921. See p. 111.

[3] Davis, B. M., "Hybrids of *Œnothera biennis* and *Œnothera franciscana* in the first and second generations," *Genetics*, 1: 197–251. 1916.

[4] East, E. M., "The Mendelian notation as a description of physiological facts," *Amer. Nat.*, 46: 633–655. 1912.

[5] Coulter, J. M., and Coulter, Merle C., "Plant Genetics." ix + 214 pp. Chicago: Univ. of Chicago Press. 1918. See pp. 40–96.

"typical Mendelian," etc. All such qualifying expressions give evidence of the recognition of the fact that usage varies regarding the significance of the words "Mendelism" and "Mendelian."

Since there are these differences of usage among geneticists, it would seem to be necessary for any one who describes a genetical situation as Mendelian or non-Mendelian, to state just what meaning is to be attached to the expression he uses. In my own usage of the expression "Mendelian heredity" it has always referred to cases such as Mendel actually observed, in which there is (statistically) independent segregation of unit factors during gametogenesis and chance recombinations at fertilization. I had this conception in mind in declaring[6] that the genetical phenomena in the Œnotheras are, with rare exceptions, non-Mendelian.

As Mendel never observed a case of linkage and no provision is made for such a phenomenon in the theory by which he interpreted his results, such cases are, on this basis, to be considered non-Mendelian,—especially as they definitely contradict the fundamental Mendelian postulate of *independent* segregation. This may perhaps with some justice be termed the strict-constructionist view. On the other hand, since it is now obvious that strictly Mendelian phenomena and linkage phenomena are products of the same mechanism and indeed that linked genes are in many cases quite indistinguishable from wholly independent ones, there is some justification for those who give a broader construction to the term Mendelian, making it essentially synonymous with chromosomal heredity as distinguished from cytoplasmic heredity.

In view of these discrepancies in usage by different authors, has not the time come to abandon the use of "Mendelian" and "non-Mendelian" as definite categories, and to adopt other terms which will have greater precision of meaning? It seems to me that the accumulation of facts from genetical investigations has reached such magnitude as to justify an attempt in this direction.

In offering a terminology for several of the fundamental categories of genetical phenomena my object is chiefly to emphasize by this means the fact that the categories themselves do exist and that they have been (and are) recognized by geneticists.

Very few (if any) geneticists will now fail to agree that the relation of hereditary factors to linkage groups, or to paired paternal and maternal material bodies, the chromosomes, must provide the basis for such a classification. Since we have long been familiar users of two words, homozygous and heterozygous, derived from the Greek root ζυγ- (ζεύγνυμι, to join, ζεῦξις, a yoking; ζυγόν, a yoke), it seems appropriate to use the same Greek root as the basis of the more complete terminology here suggested.

To distinguish between phenomena which are dependent upon the distribution of the chromosomes, and those phenomena which are to be referred to extra-chromosomal bodies or substances, we may use the nouns, *zeuxis* and *exozeuxis,* and corresponding adjectives *zygous* and *exozygous.* These alternatives correspond closely with chromosomal and cytoplasmic inheritance; but "exozeuxis" has an advantage over "cytoplasmic heredity," since some exozygous phenomena may conceivably be associated with nucleoplasmic structures or substances instead of the cytoplasm.

Under zeuxis or chromosomal heredity three fundamental relationships of hereditary factors are to be noted, depending on whether only one chromosome pair or linkage group is involved, or more than one, and whether the chromosomes concerned are behaving in typical or atypical fashion. These three categories may be named, respectively, *monozeuxis* (one pair involved), *pleiozeuxis* (two or more pairs involved), and *anomozeuxis* (involving chromosomal irregularities), and the corresponding adjectives will be *monozygous, pleiozygous* and *anomozygous.*

The last of these categories, anomozeuxis, is a composite made up of several phenomena

[6] Shull, G. H., "A peculiar negative correlation in Œnothera hybrids," *Jour. Genetics,* 4: 83–102. 1914.

of diverse nature, which have been occasionally lumped together under the expression "chromosome-exceptional," including non-disjunction (primary and secondary), triploidy, tetraploidy, etc., chromosome elimination, fragmentation, chromosomal fusions, rearrangements of whole chromosomes, or of genes in the chromosomes, etc.

Accepting the four categories represented by the terms monozeuxis, pleiozeuxis, anomozeuxis and exozeuxis, what is their relation to Mendelism? This question can be profitably discussed only if prefaced by a statement that Mendelism is here taken to include only the phenomena to which Mendel's interpretation applies, namely to the separation of each pair of alternative factors into equal numbers of germ cells in both sexes, and a purely chance assortment of the several alternatives among the several gametes, so that the permutational groupings of unit factors shall be potentially represented by equal numbers of germ cells.

Such behavior of the genes during gametogenesis provides for the production of the typical Mendelian ratios if there is neither selective fertilization nor selective elimination.

With this understanding of the phenomena to which the words "Mendelism" and "Mendelian" are appropriately applied, it will be obvious (1) that all zygous monohybrids are Mendelian. In other words, monozeuxis is Mendelian if only one pair of factors is concerned and the chromosome pair involved is behaving typically. (2) Monozygous dihybrids are likewise Mendelian whenever crossing over equals or exceeds 50 per cent. (3) All pleiozygous dihybrids or polyhybrids are Mendelian so long as no two factors in the series are monozygous with a frequency of crossing over lower than 50 per cent. (4) Anomozeuxis may under certain circumstances exhibit Mendelian phenomena. Thus in the case of non-disjunction, if the odd (unpaired) chromosome does not interfere with the normal disjunction of any other pair of chromosomes the genetical behavior with respect to qualities determined by the unpaired chromosome gives the results expected of a typical Mendelian monoheterozygote.

Non-Mendelian phenomena will be found (1) in monozygous dihybrids whenever crossing over is less than 50 per cent.; (2) in most cases of anomozeuxis, and (3) in all cases of exozeuxis.

In the Œnotheras where the question of Mendelian or non-Mendelian heredity has been most sharply and persistently raised, the situation seems now in fair way to be cleared up:

1. Exozeuxis is probably concerned in the inheritance of a variegation of the foliage which is occasionally found.

2. The *brevistylis* factor which has seemed thus far to be inherited independently of other known factors, probably represents, in relation to these other factors, a case of pleiozeuxis.

3. The occurrence of frequent irregularities in chromosome behavior (anomozeuxis) is illustrated (*a*) by the oft-repeated occurrence of the 15-chromosome forms, *albida, lata, semilata, scintillans, bipartita,* etc.; (*b*) the triploid or *"semi-gigas"* individuals sometimes called "heroes" because of their robust, *gigas*-like appearance; (*c*) the tetraploid *gigas;* and (*d*) by cases of probable fragmentation of chromosomes in forms with an extra diminutive chromosome.[7]

4. I now have on record data which demonstrate beyond question that the factors for the following characters are monozygous, being located in a single chromosome pair (chromosome I) and at a maximum distance of considerably less than 50 units: (*a*) *rubricalyx* bud pigmentation; (*b*) intense reddening of the stems; (*c*) *nanella* stature; (*d*) pink-coned buds; (*e*) *sulfurea* flower-color; and (*f*) and (*g*) two zygote lethals ("balanced"). As this group of characters makes up so large a block of those which have attracted the attention of geneticists, and as there are preliminary indications that still other factors are linked with the factors for

[7] Lutz, Anne M., "Œnothera mutants with diminutive chromosomes," *Amer. Jour. Bot.,* 3: 502–526. 1916.

the above-mentioned characters,—notably, (*h*) a pollen lethal, and (*i*) a factor for revolute leaves[8]—it can be safely stated that inheritance in the Œnotheras is comprised almost wholly in the two categories, anomozeuxis and monozeuxis, while pleiozeuxis seems at the present time to be exemplified clearly only by the relation between the factor for *brevistylis* and the other known factors, with the possibility that even *brevistylis* may one day be connected up with the same linkage group as the others, through the discovery of an intermediately placed gene.

On the whole it is now clear that while the genetical phenomena in the Œnotheras, with exception of the case of variegated foliage, can be referred definitely to the chromosomes (zeuxis), the occurrence of independent segregation which is necessary for the production of typical Mendelian behavior is so rare as to be almost negligible.

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SCIENTIFIC EVENTS

MEMORIAL TO JAMES ORTON

The governments of Bolivia and Peru have erected a monument to James Orton, the American explorer, whose grave is on Esteves island in Lake Titicaca. The funds for the memorial were given by the alumnae of Vassar College, where at the time of his death Dr. Orton was professor of natural history. The execution of the memorial was entrusted to John Ettl, the New York sculptor. It will be placed on the crest of the island which rises several hundred feet above the lake. The memorial is nine feet in height, circular in pattern with a square plinth, and in its ensemble suggests a tomb. The circular character was inspired by the tall shaft-like structures of the Incas. The dedicatory exercises will be held on September 25, the forty-fourth anniversary of Orton's death. The Peruvian Government will be officially represented, and a large attendance is expected from Arequipa, Peru and La Paz, Bolivia.

Miss Anna P. Orton, the daughter of the explorer, Mrs. Alice P. Sanford and Miss Ellen W. Farrar, Vassar alumnae, will represent the college. They take to the ceremony a stand of flags, including the Peruvian, Bolivian and American, presented by the United States Government.

James Orton was born at Seneca Falls, New York, April 21, 1830. He graduated from Williams College in 1855 and at Andover Theological Seminary in 1858. In 1866, he was appointed instructor in natural sciences in Rochester University. In 1867 a scientific expedition to the equatorial Andes and the River Amazon was organized under the auspices of the Smithsonian Institution, and Professor Orton was selected as its leader. The expedition sailed from New York on July 1, 1867, and after crossing the Isthmus of Panama, the route was from Guayaquil to Quito, over the Western Cordillera; thence over the Eastern Cordillera and through the forest on foot to the Napo; down the Rio Napo by canoe to Pebas, on to Marañon; and thence by steamer to Para, Brazil. As a result of this expedition many hitherto unknown specimens of natural history were collected and from portions of the collections in the museums of the Smithsonian Institution, the Philadelphia Academy of Natural Science, the Boston Society of Natural History, the Peabody Academy of Science, and Vassar College, while the bulk of the collection was purchased by Ingham University, Leroy, New York.

Upon his return to the United States in 1869, Professor Orton was offered the chair of natural history at Vassar College with which institution he remained until his death in 1877. In 1873 he made a second journey across South America from Para up the Amazon to Lima and Lake Titicaca, making valuable ethnological collections of Inca relics. In 1876 he organized a third expedition, with the object of exploring the great Beni River, a branch of the Madeira. This

[8] Since this was written the factor for revolute leaves has been fully demonstrated to lie in chromosome I at or very near the same level as the factor for *rubricalyx* buds and that for red stems.

expedition reached the mouth of the river, but much of the equipment and many supplies were lost. Orton, with a few companions, made the 600-mile journey back to La Paz through the forest and jungle amid incredible hardships. He died on crossing Lake Titicaca.

VACCINATION FOR SMALLPOX IN ENGLAND

THE London *Times* reports that at Nottingham, an epidemic of considerable proportions is now established; there have been 46 cases, 36 being unvaccinated, since the beginning of February. Last year a somewhat serious outbreak took place in Glasgow.

It is said that many towns in the country are badly protected at present for the doctrines of the opponents of vaccination have been widely spread. Of some areas it would be fair to say that they are destitute of protection. The population has simply refused vaccination *en masse*. An illustration—which is by no means exceptional—is Coventry, where the medical officer of health has issued the following figures:

Year	Births	Vaccinated, Percentage
1916	2,996	22.9
1917	2,738	13.0
1918	2,857	10.7
1919	2,429	8.7
1920	3,372	9.6

It was deliberate, as the following list makes quite clear:

Year	Declarations made of conscientious objections
1916	1,946
1917	1,830
1918	1,763
1919	1,250
1920	2,303

The medical officer points out that "this community is becoming largely an unvaccinated one."

What this may mean can be guessed from a series of figures published by the City of Liverpool in which the ravages of smallpox during the past 51 years are set down. The following are extracts:

Year	Deaths	Year	Deaths
1870	174	1883	26
1871	1,919	1884	106
1872	50	1885	46
1873	10	1886	29
1874	30	1887	1
1875	29	1888	1
1876	386	1889	1
1877	299	1890	None
1878	3	1891	2
1879	None	1892	13
1880	2	1893	9
1881	34	1894	20
1882	6	1895	12

The figures have remained very low since then except for the sharp epidemic of 1903 when there were 141 deaths. In 1918 there were only seven cases in England and Wales. But the sharp drop in vaccination of the past two years may be followed by a severe penalty.

THE WORK OF THE ROYAL OBSERVATORY AT THE CAPE OF GOOD HOPE

S. S. CLOUGH, H. M. astronomer at the Cape of Good Hope, has recently issued a report in which he gives an account of the distribution of the normal work of the observatory.

Dr. Halm exercises general supervision in all departments and takes part in heliometer observations and observations of an extra-routine character requiring special attention. He acts in full charge of the observatory during the absence of H. M. astronomer. Dr. Lunt is in charge of the Victoria telescope and its instrumental accessories, and of all photographic work in connection therewith.

Mr. Cox is in charge of the new meridian circle and of the time signal service, and supervises the reductions of all meridian observations. Mr. Woodgate is in charge of the astrographic telescope, photo-heliograph and seismograph, and of all photographic work connected therewith, and supervises the department of miscellaneous computations.

In addition to the above, a staff of fourteen computers and assistants is employed.

There are also attached to the observatory an instrument maker, an electric fitter, a stoker, a carpenter, and three Kroomen, who

act as messengers and keep the rooms and grounds in order.

Messrs. A. W. Long and J. F. Skjellerup, two voluntary observers, have undertaken a program of observations of variable stars, and an equatorial (either the 6-inch or the 7-inch) has been placed at their disposal as required for this purpose. The regular meridian observers during the year have been Messrs. Cheeseman, Wilkin, Peirce, Mullis, Duncan and Davis. The heliometer observations have been made by Messrs. Hough and Halm. The observations with the Victoria telescope have been made by Messrs. Lunt, Jackson and Baines, those with the astrographic telescope by Mr. Woodgate. Occasional observations of occultations, etc., have also been made by Messrs. Cox, Power and Pead.

THE INTERNATIONAL COMMISSION ON ILLUMINATION

The first technical session of the International Commission on Illumination, the successor of the International Photometric Commission, was held in Paris on July 4–8. According to the report of the meeting in *Nature* those interested in illumination problems in Belgium, France, Great Britain, Italy, Spain, Switzerland and the United States of America were represented at the session, which was opened by the Minister of Public Works, who welcomed the delegates in the name of the French Republic. The British delegates, nominated by the National Illumination Committee of Great Britain, were: Major K. Edgcumbe (Institution of Electrical Engineers, chairman of the National Committee), Mr. C. C. Paterson (hon. secretary and treasurer of the International Commission), Mr. A. P. Trotter (Illuminating Engineering Society), Dr. E. H. Rayner (National Physical Laboratory), Mr. L. Gaster (Illuminating Engineering Society), Mr. R. Watson (Institution of Gas Engineers), and Mr. J. W. T. Walsh (National Physical Laboratory, assistant secretary of the International Commission). The subjects dealt with by the commission were as follows: (1) The unit of candle-power at present in use in this country and in France and the United States was adopted for international purposes, and is to be known as the "international candle." It is maintained by means of electric incandescent lamps at the National Laboratories of the three countries named. (2) The definitions of the terms "luminous flux," "luminous intensity," and "illumination," and the units of these quantities, viz. the lumen, the candle, and the lux (meter-candle), were agreed upon. (3) The subjects of heterochromatic photometry (including physical photometry and the characteristics of the "normal eye"), factory lighting, and automobile head-lighting were also discussed at the meetings, and sub-committees were appointed to study the questions from the international point of view during the next three years. The new president of the commission is Dr. E. P. Hyde, director of the Nela Research Laboratories of America, and Major Edgcumbe is one of the three vice-presidents. The next meeting of the commission was provisionally arranged to be held in New York in 1924.

CHEMISTRY AND CIVILIZATION

The American Chemical Society, meeting this week in New York City, held on September 8 a session devoted to "Chemistry and Civilization." According to the announcement Dr. Edgar F. Smith, provost emeritus, University of Pennsylvania, would be in the chair, and the speakers were:

The rôle of chemistry, Dr. Chas. Baskerville, director of the Laboratories, College of the City of New York; chairman of the International Committee.

Energy; its sources and future possibilities, Dr. Arthur D. Little, chemical engineer and technologist, Boston.

The engineer; human and superior direction of power, Dr. Leo H. Baekeland, honorary professor of chemical engineering, Columbia University.

Chemistry and life, Sir William J. Pope, professor of chemistry, Cambridge University.

Theories, Dr. Willis R. Whitney, head of research department, General Electric Company.

Research applied to the world's work, Dr. C. E.

K. MEES, head of the research department, Eastman Kodak Company.

Problem of diffusion and its bearing on civilization, PROFESSOR ERNST COHEN, professor of chemistry, University of Utrecht.

Catalysis: the new economic factor, PROFESSOR WILDER D. BANCROFT, professor of physical chemistry, Cornell University.

SCIENTIFIC NOTES AND NEWS

DR. JOEL ASAPH ALLEN, curator of the Department of Birds and Mammals at the American Museum of Natural History since 1885, died at Cornwall-on-Hudson on August 29, aged eighty-three years.

As has already been noted in SCIENCE the Second International Congress of Eugenics, which will meet at the American Museum of Natural History, New York City, from September 22 to 28, will hold four sections. The opening addresses before the sections are announced as follows: The address before Section I, Human and Comparative Heredity, will be given by M. Lucien Cuénot, professor of zoology and physiology in the University at Nancy, France, on "Adaptation and Modern Genetic Conception"; before Section II., Eugenics and the Human Family, by Dr. Herman Lundborg, professor of psychiatry and neurology in the University of Upsala, Sweden, on "Eugenics and the Human Family." The address before Section III, Human Racial Differences, will be given by Georges Vacher de Lapouge, Poitiers, France, the title of whose address is still to be announced. The address before Section IV, Eugenics and the State, will be given by Major Leonard Darwin, of London, on "The Aims and Methods of Eugenical Societies."

THE annual summer meeting of the American Phytopathological Society was held in conjunction with the Conference of Cereal Pathologists at St. Paul, Minnesota and Fargo, North Dakota on July 19 to 22 inclusive. The following scientific men were present as invited guests of the society: Dr. E. J. Butler, Imperial Bureau of Mycology, London; Dr Kingo Miyabe, professor of botany and director of the Botanic Garden, Hokkaido Imperial University, Sapporo, Japan; Mr. R. J. Noble, and Mr. James P. Shelton, Department of Agriculture, New South Wales, Australia. Members of the society were present from Philippine Islands, from three provinces of Canada and from ten states. The meeting really constituted an international conference on cereal diseases. Drs. Butler and Miyabe will visit a number of institutions before returning home, and Mr. Noble and Mr. Shelton expect to remain for at least a year to engage in research. Professor A. Jaczewski, director of the Institute of Mycology and Phytopathology, Petrograd, Russia, and Professor N. I. Vavilov, Bureau of Applied Botany and Plant Breeding, Petrograd, Russia, arrived too late to attend the conference. They will make an extended tour of the United States and Canada before returning to Russia.

THE following honorary degrees were conferred upon members of the British Medical Association by the University of Durham on the occasion of the recent meeting of the association in that city:—*Doctor of Civil Laws:* Sir William MacEwen, Sir Thomas Oliver, and Sir Humphry D. Rolleston. *Doctor of Hygiene:* Dr. T. E. Hill and Dr. J. W. Smith. *Doctor of Science:* Sir Arthur Keith. *Doctor of Literature:* Sir Dawson Williams, editor of the *British Medical Journal. M.A.:* Dr. Alfred Cox, medical secretary of the association.

A MARBLE bust of Professor E. Fuchs, the Vienna ophthalmologist, was unveiled at the University of Vienna on June 14, the occasion being his seventieth birthday. He retired in 1915.

F. J. W. ROUGHTON, of Trinity College, Cambridge has been elected to the Michael Foster research studentship in physiology. The Raymond Horton Smith prize in medicine has been awarded to Dr. R. L. M. Wallis of Downing College.

DR. CHARLES-EDWARD AMORY WINSLOW, of Yale University, medical director of the American Red Cross, is in Geneva attending the meeting of the Health Commission of the

League of Nations. The commission plans to organize a world health institution separate from the International Health Office of the Red Cross, to which the United States belongs.

Dr. A. B. Stout, of the N. Y. Botanical Garden, has spent two weeks at the State Experimental Station at Geneva, N. Y., in making further study of flower types in grapes and in the work of breeding for seedless sorts of hardy grapes. This work is being done in cooperation with the Department of Horticulture of the Experimental Station.

Dr. Gustav T. Troedsson, privat-docent at the Geological Institute at Lund, Sweden, is accompanying Professor Percy E. Raymond, of Harvard University, on the third of the Shaler Memorial Expeditions for the study of the Ordovician in the southern Appalachians.

Dr. J. W. Kimball, formerly research chemist at Delta Laboratory, E. I. du Pont de Nemours and Co., Arlington, N. J., has joined the staff of the National Aniline and Chemical Co., as research chemist at their works at Marcus Hook, Pa.

We learn from *Nature* that a medal, to be known as the Meldola medal, will be presented annually by the Society of Maccabæans for the most noteworthy chemical work of the year carried out by a British subject who is not more than thirty years of age on completing the work. The award will be made by the council of the Institute of Chemistry acting with one member of the Society of Maccabæans, and power to vary the conditions of award is vested in the committee of the society and the council of the institute acting jointly. The object of instituting the medal is to recognize merit among the younger generation of chemists and to perpetuate the memory of Professor Raphael Meldola, the distinguished chemist who served as president both of the society presenting the medal and of the Institute of Chemistry. It is hoped that the first presentation will be made at the annual general meeting of the Institute of Chemistry on March 1, 1922.

At a meeting of the Royal College of Surgeons of Edinburgh, held on July 18, the president, Dr. George Mackay, presented to the College a portrait of the late Lord Lister. The picture is a full-sized copy made by Mr. Dorfield Hardy of the portrait painted by W. Ouless, R. A., in the possession of the Royal College of Surgeons of England. In accepting the portrait on behalf of the College, the vice-president, Dr. McKenzie Johnston, expressed the satisfaction the college had in acquiring this memorial of its most distinguished fellow through the generosity of their president.

The Priestley Memorial Committee of the American Chemical Society has reported that the sum of two thousand dollars has been collected and placed on interest. The committee has authorized the chairman to select an artist to copy the Stuart portrait of Priestley, which is now at Northumberland, Pa., and immediate steps will be taken to obtain a die for the Priestley medal.

Peter Cooper Hewitt, the electrical and mechanical engineer of New York City, died in Paris on August 25.

W. Horace Hoskins, professor of veterinary jurisprudence and dean of the New York State Veterinary College at New York University, died on August 17, aged sixty-one years.

W. E. Rolston, associated with Sir Norman Lockyer in the work of the Solar Physics Observatory at South Kensington until he enlisted in 1915, has died at the age of forty-five years.

UNIVERSITY AND EDUCATIONAL NEWS

The *Journal* of the Americal Medical Association states that members of the medical faculty of the University of Maryland Medical School, have placed their resignations in the hands of Dr. Albert F. Woods, president of the university. This action has been initiated by the medical men themselves in order that the faculty might be reorganized on a "half-time pay" basis. Plans for reorganization call for doubling the $500,000 a

year now expended by the hospital and medical school for running expenses, and providing a building fund of $1,000,000.

DR. LEE I. KNIGHT, of the department of botany, University of Minnesota, has been appointed chairman of that department.

DR. HARRY F. LEWIS, A.B. and A.M., Wesleyan University, and Ph.D., Tilden, Illinois, has been elected associate professor in chemistry at Cornell College.

DR. JOSEPH L. MAYER, chief chemist of the research and analytical laboratories of the Louis K. Liggett Co., New York, has been appointed professor of analytical and pharmaceutical chemistry in the Brooklyn College of Pharmacy where he has been associate professor of analytical chemistry for several years.

S. C. OGBURN, JR., graduate of the University of North Carolina, has been appointed instructor in chemistry at Washington and Lee University.

JAMES L. HOWE, JR., who has been for three years assistant professor of chemistry in Washington and Lee University, has accepted the professorship of chemistry in Hangchow Christian College, China.

H. P. PHILPOT, assistant professor at University College, London, has been appointed to the professorship of civil and mechanical engineering at the Finsbury Technical College; and A. J. Hale, chief assistant in the department of applied chemistry, has been appointed to the professorship in that department.

DISCUSSION AND CORRESPONDENCE

THE CHERT PITS AT COXSACKIE, N. Y.

A REMARKABLE series of chert pits and two large quarries two miles south of Coxsackie, N. Y., is being examined by the archeological staff of the State Museum of New York under the leadership of State Archeologist Arthur C. Parker.

These pits are on the property of the West Shore Railroad and cover the greater portion of an elongate hill a mile in length and some one thousand feet in width. The hill is covered with the refuse of aboriginal excavations. The steep slopes are covered in places to a depth of six or more feet with the rock broken from the pits and quarries. One immense dump is more than a hundred feet long and eight feet in thickness and contains besides the waste rock the rejected blocks of flint and many broken or partially completed implements. Broken rock occurs in such quantities that the railroad purchased the property thinking it an enormous bed of broken stone suitable for road bed ballast.

Mr. Parker is making a survey of the hill in order to make a relief model of it for a museum exhibit. The artificial nature of the broken stone was discovered by Mr. Jefferson Ray, of West Coxsackie, who made a collection of 1,500 chipped chert implements from the workshop sites on the flats below the hill.

The site is an exceedingly old one and must have been worked by three or four hundred Indians at a time for a period of 500 to 1000 years, judging from the large quantities of flint found upon it. The site is a remarkable one and is a unique archeological monument that will well repay visitation by archeologists and geologists interested in securing data bearing on the stone age.

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THE USE OF AGAR IN FACILITATING THE REMOVAL OF A SWALLOWED FOREIGN OBJECT

OPPORTUNITY of experimentation and observation in the use of agar in assisting in the removal of a foreign object from the stomach came to the writer in the case of a child, four and one half years old, who had swallowed a safety pin. The pin was an ordinary nickeled pin, one and one half inches long, and was closed.

According to the best medical practise the use of purgatives or cathartics in such emergency is to be avoided, as such would tend to liquefy and remove the bowel content leaving the object unsupported; and moreover any

purgative acting by irritation of the bowels might cause such peristalsis as to allow the pin to become caught in the contracting action in such a manner as to become permanently imbedded. The removal by natural action is deemed best, aided by the feeding of much bulky food to stimulate natural peristaltic action, and to form encasement for the foreign object.

In accordance with these principles the child was induced to eat as much bulk-forming food as possible, as shredded wheat, oatmeal, bread and milk, potatoes, carrots, spinach and celery. Milk was allowed after the appetite had become satiated with the solid food.

In order to make more certain the removal of the object, as well as to hasten the action, it was conceived that the addition of agar to the diet would be highly beneficial. Since agar is not digested and swells to several times its bulk its effect would be not only to hasten peristalic action by natural stimulation, but its added bulk would assist in encasing the object and in carrying it along. It was reasoned that its effect would be of especial value in those portions of the digestive tract in which the digestible food is in the state of emulsification.

At evening and morning meals therefore, there was added to a little of the prepared cereal, three heaping teaspoonfuls of chocolate-coated granular agar. This was eaten by the child readily and with relish.

As the child tended somewhat toward constipation, the removal of the previous fecal matter was hastened by the use of a glycerol suppository. The later actions were wholly normal. The first feeding occurred in the evening, soon after the swallowing of the object. Bowel action occurred as follows: 16 hours, 23 hours, 40 hours, at which time the pin appeared. The stools were copious and of a moist, compact, firm structure—an ideal consistency to carry a foreign object. As bowel action occurred twice daily, instead of the usual once; and as the bulk of each was at least twice normal; it is evident that the bowel content had been increased by fourfold, due in a large measure to the agar.

It is not to be supposed that the safe removal of the object was due wholly to the agar, though this probably at least hastened its removal. As the experiment was wholly satisfactory however it would lead to the recommendation of the use of agar for this purpose. In the case of the removal of objects more dangerous, or more difficult of removal, it might prove a decisive factor.

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AN INCONSISTENCY IN TAXONOMY

In the classification of animals we are often very inconsistent in the use and evaluation of characters as we apply them to different groups. This is more apparent between widely separated groups than closely related ones. Thus in the subgroups in one class of the vertebrates, osteological or other anatomical characters may be largely used, while in another class such internal characters may be almost entirely subordinated to external ones. Sometimes, to be sure, certain characters have not the same value in one class that they have in another, but the main reason for the inconsistency lies in the less skilful or less thorough handling of one group as compared with another. The truth is, classification became unfashionable long before the groups, especially the larger ones, were well formulated. Among groups as small as genera there are probably few cases so extreme as the following.

There are two genera of sharks, *Mustelus* and *Cynias,* that are strikingly similar in all external characters. We refer them to different genera because they differ in regard to a modification of the yolk sac in the young. In *Mustelus* the yolk sac is modified to function as a placenta by which the young forms a connection with the walls of the mullerian duct of the mother. This so-called placenta is absent in *Cynias,* or, more correctly speaking, the yolk sac is unmodified.

On the other hand, we place two mackerel together in the genus *Scomber* even though

one of them possesses an entire organ that is absent in the other. *Scomber scombrus* is without a swim bladder; *Scomber japonicus* has a well-developed one.

This is a most glaring inconsistency. On one hand, to separate two genera on the basis of a mere modification of an organ that is possessed by both of them, and on the other hand, to include in one genus two forms, one of which possesses an organ that is absent in the other. Making this inconsistency more marked is the fact that in the case of the sharks it is only during a part of the life of the animals (when they are with young) that the character of the 'placenta,' upon which the genus is based, can be ascertained. In the mackerel the presence or absence of the swim bladder can be seen at any time by simply opening the abdominal cavity.

On the whole, workers in vertebrate taxonomy seem to be more chary than those in invertebrate, in making use of internal characters in classification. The fact that a character is not readily apparent should not influence its use if animals are to be arranged in their true relationship.

Such a marked structural difference as the possession of an organ as compared with the suppression of it certainly should be considered of generic weight. Therefore it would seem well to raise the subgenus *Pneumatophorus* Jordan and Gilbert, to generic rank. The American species, *Scomber colias* and *S. japonicus,* would thus stand *Pneumatophorus colias* and *P. japonicus.*

EDWIN C. STARKS

AN IMPROVED METHOD OF ESTIMATING THE NUMBER OF GENETIC FACTORS CONCERNED IN CASES OF BLENDING INHERITANCE

DR. SEWALL WRIGHT has kindly pointed out an error in the formula which I recently suggested[1] in connection with this subject. Instead of taking the direct difference between the standard deviations of F_1 and F_2, as I did, one should deal with the difference between the *squared* standard deviations. Dr. Wright bases this correction on his discussion of the fundamentals of factorial theory as developed particularly in "Systems of Mating IV.," *Genetics,* 6, March, 1921. He gives the correct formula for the number of factors (n) concerned in a case of blending inheritance as

$$n = \frac{D^2}{8(\sigma_2^2 - \sigma_1^2)},$$

in which D is the difference between the means of the parental races, σ_1 is the standard deviation of F_1, and σ_2 is the standard deviation of F_2. This method gives in general a smaller number of genetic factors than the method which I suggested, and its use is simpler. Applied to the examples which I cited, it gives, in the case of seed weight of maize, 4 or 5 factors instead of "about 15"; and in the case of weight of rabbits in three different crosses, 3, 14 and 22 or 23 factors, instead of 56, 80, and 176, respectively. I am greatly indebted to Dr. Wright for the correction.

W. E. CASTLE

[1] SCIENCE, July 29, 1921.

THE CURVE OF DISTRIBUTION

TO THE EDITOR OF SCIENCE: An explanation of the irregularities in the curve of the distribution of the heights of 221,819 men, taken from insurance statistics, to which Professor Boring called attention in SCIENCE for November 12, 1920, may possibly be found in the nature of the measuring devices used by the examining physicians. One of the three leading types on the market and at least one other are graduated in inches alone instead of in feet and inches. The tendency for men who use these scales to read off the round number, 70 inches, instead of 69, and 60 inches instead of 59, might be great enough to account for the "bumps" in the Gaussian curve at 5 ft. 10 in. and at 5 ft.; and the lowering of the average height which would result from the correction of these exaggerations might change the ideal curve sufficiently to bring the bump at 5 ft. 8 in. within the normal limits of error for a curve whose unit of measurement is so large in comparison to the total range of variation.

CARL H. P. THURSTON

PASADENA, CALIF.

QUOTATIONS

DYES FOR BACTERIOLOGY

Bacteriologists in this country and in the United States of America are anxious about the supply of chemical dyes used in their work. Animal tissues and the microbes which may infest them, as seen under the microscope, present to the eye an almost uniform appearance of pale translucency. A skilled treatment with dyes and mordants reveals the otherwise invisible differences of structure and composition. Particular cells and granules, bacteria and spores, have affinities for particular stains, and betray their presence by the colors they absorb. The presence, the quality, and even the phase of an infection or of a morbid state are thus detected, and the processes are a necessary part of research, diagnosis, and treatment. But the reactions are delicate, and their value depends on a high purity and standardization of the reagents employed. The materials are almost entirely the aniline dyes used in textiles. Before the war Grübler in Germany had examined these and selected those that might be of use to biologists. The total bulk of the trade is very small, and the German manufacturer had taken so much trouble to standardize his products and secure their purity that he had a practical monopoly and was able to charge a high but legitimate price. When the war came, in 1914, a few fortunate institutions had in hand a stock of the Grübler reagents sufficient to meet their wants. But the greater number of biologists were soon in difficulties. Here and in the United States several manufacturers, partly from patriotic motives and partly from the attraction of the great difference in price between the crude textile dyes and the microscope stains, began to supply the demand. There is no reason to suppose that their output was inferior to the German products. But it varied from manufacturer to manufacturer in its precise qualities. The users got results which were not exactly comparable with those obtained from the Grübler products or with each other. The total demand, moreover, is so small in bulk that it is hardly worth distributing. The situation has given rise here and in America to a desire for the free importation of German bacteriological stains, on the one hand, and, on the other, to fresh efforts to maintain national independence in this branch of scientific work. The Society of American Bacteriologists is endeavoring to secure cooperation in determining on a reliable standard brand of each kind of stain, and in discouraging the marketing of variants. A similar course in this country would be very convenient.—The London *Times*.

SPECIAL ARTICLES

THE SECOND-YEAR RECORD OF BIRDS WHICH DID AND WHICH DID NOT LAY DURING INDIVIDUAL MONTHS OF THE PULLET YEAR

The egg output of the commercial poultry plant is due in part to birds in their first and in part to birds in their second year. At some time during the first year the number of pullets is reduced to the number which is to be retained as hens during the second year.

It would be of obvious advantage if the birds sold from the flock as pullets could be those which if retained would make the poorest record in their second year. If the birds destined to be the highest producers in the second year could be selected on the basis of some criterion recognizable in the first year, it should be possible to raise the average production of the flock as a whole by increasing the average production of the hens.

In the course of a general investigation of the problem of the prediction of the egg production of the domestic fowl from the records of short periods, we have availed ourselves of the opportunity of considering the relationship between first and second year laying activity presented by the data of the Vineland International Egg Laying and Breeding Contest. As one phase of this work[1] we have sought to determine to what extent the simple criterion of *laying* versus *not laying* in any month of the first year may be used

[1] Other phases of the investigations will be reported in detail elsewhere.

in predicting the record of the second year. The criterion has already been considered in relation to the prediction of first year egg record.[2] While our immediate purpose is the consideration of the second year production of birds which did and of those which did not lay during given months of the first year, it seems desirable to give the mean first year productions of these birds as well. For comparison the results deduced from the data

[2] Harris, Blakeslee and Kirkpatrick, *Genetics*, 3: 42–44, 49–56, 1918.

MEAN ANNUAL PRODUCTION FOR FIRST AND SECOND YEAR FOR BIRDS WHICH DID AND WHICH DID NOT LAY DURING INDIVIDUAL MONTHS OF THE FIRST YEAR

Condition of bird in month of first year	Storrs data for first year		Vineland data for first and second year		
	Per cent. of flock	First year annual mean	Per cent. of flock	First year annual mean	Second year annual mean
November					
Not laying	40.6	136.8	19.4	144.5	127.8
Laying	59.4	164.2	80.6	181.2	142.7
Difference		+ 27.4 17.9%		+ 36.7 21.1%	+ 14.9 10.7%
December					
Not laying	38.0	133.6	22.3	142.3	125.9
Laying	62.0	165.2	77.7	183.2	143.8
Difference		+ 31.6 20.6%		+ 40.9 23.9%	+ 17.9 12.8%
January					
Not laying	42.5	136.4	20.5	141.6	124.4
Laying	57.5	165.6	79.5	182.4	143.8
Difference		+ 29.2 19.1%		+ 40.8 23.4%	+ 19.4 13.9%
February					
Not laying	9.9	118.6	5.0	133.6	117.0
Laying	90.1	157.0	95.0	176.2	141.0
Difference		+ 38.4 25.1%		+ 42.6 24.5%	+ 24.0 17.2%
July					
Not laying	2.3	72.3	3.1	110.6	92.5
Laying	97.7	155.1	96.8	176.1	141.3
Difference		+ 82.8 54.1%		+ 65.5 37.6%	+ 48.8 34.9%
August					
Not laying	5.1	89.9	7.2	121.6	99.5
Laying	94.9	156.5	92.8	178.1	142.9
Difference		+ 66.6 43.5%		+ 56.5 32.5%	+ 43.4 31.0%
September					
Not laying	23.0	115.0	33.2	147.8	124.3
Laying	77.0	164.6	66.8	187.1	147.5
Difference		+ 49.6 32.4%		+ 39.3 22.6%	+ 23.2 16.6%
October					
Not laying	54.7	131.9	63.2	156.9	129.8
Laying	45.3	178.9	36.8	203.5	157.0
Difference		+ 47.0 30.7%		+ 46.6 26.8%	+ 27.2 19.5%

of the International Egg Laying Contest at Storrs during the year 1913–'14 and 1914–'15 [3] are laid beside those presented here from the Vineland data.

The essential constants appear in the accompanying table. This gives the per cent. of the flock which did and which did not lay during the months of the first year in which any considerable proportion of the birds did not lay. The average annual production for these birds in the first year of both the Storrs (1913–'14 and 1914–'15) and the Vineland (1916–'17) contests and in the second year (1917–'18) of the Vineland contest are shown. While the actual differences in egg production are the data of practical significance, comparison between the three series is facilitated by expressing the differences between these annual means for the birds of the two classes as percentages of the actual annual average productions[4] of the flock.

Considering first the records of the pullet year we note that for the Storrs series the birds which laid in any given month show an average annual (pullet year) egg production of from 27.4 to 82.8 eggs higher than those which did not lay or from 17.9 to 54.1 per cent. For the Vineland series the difference in the production of the two groups ranges from 36.7 to 65.5 eggs or from 21.1 to 37.6 per cent. Thus the difference in the annual egg production of the birds which did and which did not lay in any given month, as well as the percentage of the birds which are not laying, varies greatly according to the month considered. During the months of November, December and January the percentage differences in the annual production of the two groups of birds is higher in the Vineland than in the Storrs series whereas for the other months of the eight considered the reverse is true. The average percentage difference is 30.4 in the Storrs series and 26.6 in the Vineland series.

[3] Harris, Blakeslee and Kirkpatrick, *loc. cit.*, p. 42.

[4] These are 153.19 eggs for the first year at Storrs, 174.05 eggs for the first year at Vineland, and 139.79 eggs for the second year at Vineland.

Thus the constants show conspicuous differences of great practical significance in the first (pullet) year records of birds which did and those which did not lay during the individual months of the first year. The results for the first year records at Storrs and the first year records at Vineland are in fair agreement.

Turning to the second year means we note that for each of the eight months of the first year used as a basis of selection for an increase of second year production, the second year record of birds is higher if they laid during the special month under consideration in the first year than if they did not lay in that month. The differences between the groups amount to about two dozen eggs or more per bird in five of the eight months considered.

It is clear, therefore, that so simple a criterion as laying *vs.* non laying in the first year may furnish a criterion of some value for the selection of the birds to be retained in the flock for breeding and for second year production.

J. Arthur Harris,
Harry R. Lewis

THE AMERICAN CHEMICAL SOCIETY

(continued)

DIVISION OF INDUSTRIAL AND ENGINEERING CHEMISTRY

H. D. Batchelor, *chairman*
H. E. Howe, *secretary*

Symposium on Drying. Charles O. Lavett, *chairman*

The rate of drying of solid materials: W. K. Lewis.

The theory of atmospheric evaporation: W. H. Carrier.

The compartment dryer: W. C. Carrier and A. E. Stacey. A discussion of the relative merits of the continuous and compartment dryers.

Direct heat rotary drying apparatus: R. G. Merz. The paper was treated under the following heads: (1) The kinds and characteristics of direct heat rotary dryers. (2) The fields of application of such drying apparatus to the industries where they can be used to advantage. (3) The

advantages and limitations of these machines. (4) Efficiency is dependent upon the physical characteristics of the material to be handled, the initial and final moisture contents, the kind of fuel employed and the method of application of the drying medium. (5) When use of waste heat from other processes is advisable and economical.

Tunnel dryers: GRAHAME B. RIDLEY. For the purposes of this paper, tunnel dryers are limited to those having material on trays which are moved progressively through a tunnel which is supplied with a current of heated air from which all the heat used for drying is obtained and by which all the moisture is removed. Details of their operation were described.

The spray process: R. S. FLEMING.

Vacuum drying: CHAS. O. LAVETT and D. J. VAN MARLE. The paper gave an outline of the principles of vacuum drying, in particular the heat transmission and the influence of the vacuum on the temperature and rate of evaporation. A more detailed description was given of the vacuum shelf, rotary and drum dryer, their construction, application and cost of operation.

Tests on counter-current kelp driers: G. C. SPENCER and E. B. SMITH. Details were given of tests made at the kelp-potash plant of the U. S. Bureau of Soils at Summerland, Calif., during the year 1918.

The preparation, properties and constitution of liquid and solid water-glasses: LOUIS SCHNEIDER. Liquid water-glass may be prepared by a number of methods, of which the furnace process is at present the most widely employed in this country. Solid water-glass may be produced by dehydration, hydration, synthetic and crystallization methods. A practical crystallization method is unfortunately limited to the meta-silicate ratio. A continuous dehydration method at atmospheric pressure offers the best means of attaining a stable and completely soluble water-glass at a low cost. A number of important properties of liquid and solid water-glasses, as well as of sodium meta-silicate crystals and silicic acid hydrogels, have been fully described. It has been shown that solution and not dilution occurs when a solid water-glass is mixed with water. Viscosity is mainly a function of the sodium meta-silicate content. The free causticity of concentrated liquid water-glasses may be ascertained by the attainment of the heat of solution of a hydrated silica in the concentrated liquid water-glass and in a dilute caustic soda solution. It has been established (*a*) that a liquid water-glass is primarily a solution of sodium meta-silicate, silicic acid and, if the maximum solubility of the latter is exceeded, silicic acid hydrogel; and (*b*) that a solid water-glass, above the ratio of 1 Na_2O : 1SiO_2, is a mixture of hydrated sodium meta-silicate and an incompletely dehydrated silicic acid hydrogel. A system of nomenclature has been proposed to eliminate the prevalent indefiniteness of the terms employed in the literature and the trade.

Method for treating filter cake obtained in refining vegetable and animal oils: CHARLES BASKERVILLE. According to the Baskerville process, vegetable and animal oils are refined by treating with caustic, a determined amount of cellulose such as paper pulp or "linters" being mixed in with the oil, and heating to a "break." The soap particles are hardened and colloids are agglomerated by the further addition of anhydrous sodium sulphate or sodium carbonate. The insoluble mass thus produced is filtered out. The filter cake obtained may be subjected to squeezing in another press whereby some whole oil is recovered and a more compact cake results. The author also devised a process for recovering the remaining whole oil and the fatty acids in the cake. It depends upon cooking up the cake with an acid solution and running the completely disintegrated acid mass, the linters or paper pulp forming a filtering medium, which makes a complete separation of the hot mixture of free fatty acids and water solutions of salts and acids from the fiber. The free fatty acids and the whole oils rise to the top of the mixture and may be separated by any of several well-known methods, washed with hot water, the product being thus converted into a soap making material containing approximately fifty per cent. free fatty acids and fifty per cent. whole oil. A patent covering the process has been applied for.

The application of the Cottrell precipitator to the wood distillation process: L. F. HAWLEY and H. M. PIER. Recent experiments on a wood distillation retort holding about 75 pounds of wood have shown that the Cottrell precipitator can remove from the vapors coming from the retort practically all of the tar. The pitch formed during the distillation of the wood is non-volatile and is carried over to the condenser in the form of a fog of fine particles. If the precipitator is kept at too high temperature the pitch precipitated is so hard that it builds up across the tubes and causes short

circuiting. If, however, the precipitator is operated at a temperature near the boiling point of water a certain amount of oil and water is precipitated with the pitch so that a thin liquid is precipitated which does not cause short circuiting. By the application of the precipitator in this way it is hoped to be able to provide a pyroligneous acid direct from the condenser in sufficient purity so that it will not have to be redistilled to remove the tar.

Alcohol and chemical industries: J. M. Doran. The present and future development of our chemical industries, notably our dye industry, is intimately bound up with our alcohol industry. The eighteenth amendment to the Constitution and the Volstead Act affect this key industry far more vitally than the average chemist is aware. Title III. of the National Prohibition Act accords special treatment under the law to industrial alcohol but overshadowing all are the prohibition features of Title II. of the same act wherein alcohol is defined as intoxicating liquor and subject to the restrictions surrounding intoxicating liquor. In order to free the alcohol industry and dependent and allied chemical industries from the strangling rules surrounding liquor under which no industry can prosper, it is of utmost importance that alcohol be divested of its beverage character. The handling and use of pure alcohol in any industry is now a liability rather than an asset. Under the denaturing provisions of the National Prohibition Act it is possible both to enforce prohibition and assure the healthy development of industrial alcohol. The solution of this problem is essential if we are to have a healthy chemical industry.

The caustic calcination of dolomite and its use in sorrel cements: G. A. Bole and J. B. Shaw. Magnesium limestones can not be burned successfully by present methods as the calcium carbonate gives rise to free lime which is detrimental to the sorrel reaction. The pressure of carbon dioxide may be so regulated as to prevent the liberation of free lime. An oxide produced at 700 to 750° C. is superior to that burned at any other temperature-data given. All dolomites do not act alike in calcining but some dissociate at a much lower temperature than others. The conclusion is drawn that when properly burned, *i.e.*, temperature and pressure controlled, some dolomites, but not all, will produce an oxide well suited for stucco mixes.

Valuation of oil-bearing seeds by free fatty acid of the oil: Lehman Johnson. The petrolic ether extract from 16 grams of cotton seed thoroughly dried at 103° C. was titrated for free fatty acid and found to bear a true relation to the free fatty acid of the hydraulically expressed oil. This test will serve to determine the quality and proximate refining loss where the alkaline method of refining is to be employed on the oil. It is suggested as a more scientific and fairer method of valuing cotton seed than the "out and count" of damaged seed method now in use. It is probably applicable to other oil-bearing seeds.

The detection of carbon monoxide: C. R. Hoover. Carbon monoxide reacts at ordinary temperature with mixtures of iodine pentoxide and fuming sulfuric acid to give carbon dioxide and iodine or compounds of oxides of iodine and sulfur. With excess of sulfur trioxide colors are obtained varying with the concentration of carbon monoxide from pale green to dark brown. This reaction has been applied to the detection of carbon monoxide and other reducing gases. In the laboratory simple apparatus enables one to determine carbon monoxide quantitatively when present in amounts varying from .01 per cent. to 1 per cent. Two simple portable devices have been constructed by means of which an approximate quantitative determination of carbon monoxide from .03 per cent. to 1 per cent. can be carried out in thirty seconds.

Microscopic illumination with reference to Brownian movement and combination lightning: A. Silverman. Brownian movement can be studied against a black background by direct illumination from a ring lamp surrounding the objective. This results in a marked contrast and gives unusual definition to the particles. Second, the use of combination lighting from the ring lamp for opaque objects imbedded in transparent media results in the desired contrast between the object and medium and shows the details of the object itself by the reflected light. This is accomplished by placing the concave mirror parallel to the stage of the microscope so that the light travels through the transparent medium to the substage reflector and is sent up again to produce the contrast. The details in the opaque object are obtained by the direct light from above.

The relation of structures to free alkali in sodium silicate solutions: William Stericker. Although the general opinion is that solutions of sodium silicate contain large quantities of free alkali, they probably do not. The misconception is due to a lack of a satisfactory method for the determination of the degree of hydrolysis. Ultramicroscopic examination proves that sodium silicate

solutions are two-phase systems in which the dispersed phase has a negative charge. Probably hydroxyl ions are absorbed on the particles and attract sodium ions to form double layers which cause higher concentrations of alkali at the interfaces than elsewhere in the solution. This hypothesis explains discrepancies between the results from various methods.

Compression evaporation: A new method of concentrating liquids developed in Europe recently: GUSTAV CARLSSON.

Action of lime on greensand: R. NORRIS SHREVE. The Eastern Potash Corporation has under construction at New Brunswick, N. J., a large plant for obtaining caustic potash and other potash compounds from greensand. The main reaction in the process is the action of lime in decomposing greensand whereby caustic potash is liberated and a valuable residue obtained, which possesses considerable cementitious properties. In the reaction the lime attacks the greensand, or rather the glauconite contained therein, when heated with the greensand in the presence of water and at elevated temperatures and under sufficient pressure to keep the water in the liquid phase.

A modification of the acetate method for estimating iron and albumen in phosphates: F. P. VEITCH and H. P. HOLMAN. As a result of cooperative work with the fertilizer division of the American Chemical Society and also independent investigations, certain modifications have been made in the acetate method for estimating iron and aluminum in the presence of lime and phosphoric acid. This method, in substantially its present form, was submitted by the authors to the committee on research and analytical methods of the fertilizer division and was published as a part of that committee's report on phosphate rock in *Journal of Industrial and Engineering Chemistry*, 7, pp. 446–448. The present article made further modifications as a result of subsequent work, discussed the reasons for the conditions described as necessary for accurate results by this method, and gave results obtained on solutions of known compositions.

The water resistance of treated canvas during continuous exposure to weather: F. P. VEITCH and T. D. JARRELL. This paper gives a detailed report on the water resistance of gray 12 oz. U. S. standard army duck, which had been treated with eighteen formulas developed in the Bureau of Chemistry. The degree of water resistance was determined in the laboratory by modified funnel and modified spray methods and also in actual service by exposure to weather for 14 months. General conclusions are drawn as to the effectiveness of the various treatments. The treatments which have proved most serviceable by exposure test have also given high results by the funnel test. However, not all treatments showing a high rating by the funnel test have proven highly serviceable in those cases where water lay for some time on the canvas.

The detection and estimation of coal tar oils in turpentine: V. E. GROTLISCH and W. C. SMITH. The method outlined includes the following steps: (1) passing dry hydrogen chloride gas into the liquid, thus converting the pinene into crystalline pinene hydrochloride, also raising the boiling points of the unprecipitated reaction products; (2) distillation of the filtrate under reduced pressure to separate the coal tar oils with a minimum of terpene bodies; (3) sulphonation of the distillate with fuming sulphuric acid, thereby destroying terpenes and converting coal tar hydrocarbons into sulphonic acids; (4) dilution and steam distillation of the sulphonation mixture to remove undecomposed terpenes or mineral oils; (5) direct distillation of the sulphonation mixture to break up the sulphonic acids, with recovery of the coal tar hydrocarbons.

CHARLES L. PARSONS,
Secretary

THE ROYAL SOCIETY OF CANADA

THE following papers were presented before the Mathematical, Physical and Chemical Section of the Royal Society of Canada at the meeting held in Ottawa on May 18, 19 and 20:

Presidential Address.—"Division in relation to the algebraic numbers," by Professor J. C. Fields. "Ionization potential and the size of the atom," by Professor A. S. Eve. "Detection of variation in electric earth currents by coil and galvanometer," by Professor A. S. Eve and Mr. E. S. Biehler. "The effective range of beta-rays," by Miss V. Douglas and Dr. J. A. Gray. "The velocity of sound in air and soil; Properties of x-rays excited by beta-rays; The absorption of gamma-rays; A note on the examination of materials by x-rays," by Dr. J. A. Gray. "The transmission of heat through the thin boundary films of air or of water at the surface of glass," by Dr. A. Norman Shaw and Mr. L. S. Smith.

"The viscosity of ether at low temperatures and solution of acetic acid in liquid hydrogen bromide," by Dr. E. H. Archibald, Mr. C. E. Stone and Mr. E. M. White. "Preliminary report on the lubricating properties of the different series of hydrocarbons," by Dr. W. F. Seyer. "An automatic mercury pump," by Dr. D. F. Steadman. "Some results of the destructive distillation of British Columbia alder and Douglas fir," by Mr. W. A. Hardy. "On the variation of the 'emanating power' of certain uranium minerals with temperature and a new secondary radium emanation standard," by Dr. J. H. L. Johnstone. "The effect of thermo-luminescence on electrical conductivity," by Mr. C. A. Mackay. "The anemometer factor; pilot balloon methods in Canada," by Mr. J. Patterson. "On some new formulæ for the direct numerical calculation of the coefficient of mutual induction of coaxial circles;" "On a new high frequency vibration galvanometer;" "On the photographic recording and measurement of radiotelegraph signals;" "On a new lecture room illustration of atomic models," by Dr. Louis V. King. "On the refractive indices of metallic vapors," by Professor J. C. McLennan. "On the absorption spectrum of liquid and gaseous oxygen," by Mr. W. W. Shaver. "On the structure of the Balmer series lines of hydrogen," by Professor J. C. McLennan and Mr. P. Lowe. "On the spectrum of helium, hydrogen and carbon in the extreme ultraviolet," by Professor J. C. McLennan and Mr. P. A. Petrie. "On the liquefaction of hydrogen," by Professor J. C. McLennan. "Nitrophthalic anhydrides and acetylamino-phthalic anhydrides with toluene and aluminium chlorides," by Mr. W. A. Lawrence. "Bromphthalic anhydrides with benzene and aluminium chloride," by Mr. H. N. Stephens. "The effect of certain chemicals on the rate of reproduction of yeast," by Mr. N. A. Clark. "The passage of hydrogen and of helium through silica tubes," by Professor J. B. Ferguson and Mr. G. A. Williams. "The action of methylgreen on yeast," by Mr. W. B. Leaf. "Pressure-volume relations of superheated liquids," by Mr. K. L. Wismer. "Scattering of light by dust-free liquids," by Mr. W. H. Martin. "Note of Wolski's paper on optically empty liquids," by Professor F. B. Kenrick. "Redetermination of the melting point of sodium chloride," by Professor J. B. Ferguson. "Researches in physical and organic chemistry carried out in the chemical laboratory of the University of Toronto," communicated by Professor W. Lash Miller. "On the reduction of the circulants to polynominal form with applications to the circulants of the 7th and 11th degrees," by Dr. J. C. Glashan. "The gravitation potential of an anchor ring; some tidal problems," by Professor A. H. S. Gillson. "Law of distribution of particles in colloidal solutions," by Professor E. F. Burton and Miss E. S. Bishop. "Production of heat during charcoal absorption," by Mr. Stuart McLean. "The relation between coagulative power of electrolytes and concentration of colloidal solutions," by Professor E. F. Burton and Mr. E. D. MacInnes. "The radial velocities of 570 stars;" "The orbit and dimensions of TV Cassiopeae;" "The temperature control of the stellar spectrograph," by Dr. J. S. Plaskett. "The orbital elements of the brighter components of Boss 497;" "The orbits of spectroscopic components of Boss 4622," by Mr. W. E. Harper. "The intensity distribution in typical stellar spectra," by Mr. H. H. Plaskett. "The solution of plane triangles by nomographic charts," by Dr. S. D. Killam. "Note on the geometrical equivalence of certain invariants," by Dr. Charles T. Sullivan. "The interpolation of breaks in tide curves for recording gauges," by Dr. W. Bell Dawson. "The vertical movement of alkali under irrigation in heavy clay soils;" "Notes on the nature of burn-outs," by Dr. Frank T. Shutt and Miss Alice H. Burwash. "Reversible pendulum," by Professor H. F. Dawes. "Characteristic x-rays from boron," by Professor A. L. Hughes. "A new experiment in vibration," by Professor John Satterly. "Note on the spectra of potassium;" "Note on infra-red spectroscopy," by Professor J. C. McLennan. "Selected radiation emitted by specially excited mercury atoms," by Mr. H. J. C. Ireton.